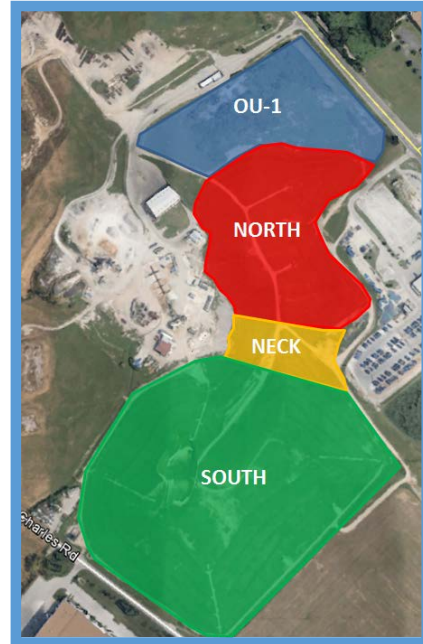


Bridgeton Landfill Data Review Update

Primarily Reflects Data and Documents Published on MDNR's Webpage for data collected in February 2016

Introductory Remarks

The ORD Engineering Technical Support Center (ETSC) and their subcontractor reviewed data and reports at the Missouri Department of Natural Resources (MDNR) Bridgeton Landfill website. The purpose of the review was to examine available reported data collected at the landfill gas extraction wells (GEWs), gas interceptor wells (GIWs), and temperature monitoring probes (TMPs) to assess the presence and progression of any subsurface oxidation event/heat-generating event occurring in the South Quarry, North Quarry or the adjoining “Neck” area (*see figure on right for an approximate depiction of these areas and the adjacent Westlake Landfill OU-1 cell*). The shaded areas shown in the figure are intended to provide a quick reference to different areas of interest. This report analyzes data primarily collected in February, 2016.



The closure of the South Quarry and North Quarry landfill cells was approved by MDNR in 2008 and 2010, respectively. The landfill cells were closed with a 2-ft thick clay cap (with hydraulic conductivity $< 1 \times 10^{-5}$ cm/sec) overlain by a 1-ft thick vegetative soil layer. An ethylene vinyl alcohol (EVOH) flexible membrane cap was placed over the South Quarry, Neck Area, and a portion of the North Quarry in 2013 and 2014. Work was initiated in the South Quarry at various times in 2014 and 2015 to repair slopes that had subsided. A North Quarry cap enhancement project (approved by MDNR on 27 January 2016) was recently initiated, this includes installing a flexible membrane liner between the edge of the EVOH liner and the perimeter road, along with associated stormwater management and gas management infrastructure. Additional information on this plan is available on the MDNR website (link above).

This document provides a summary and discussion of data collected in North Quarry, Neck Area, and South Quarry of the landfill. Observations on the flare data are also provided below:

- The average flow rates of methane (CH₄) (338 standard cubic feet per minute (scfm)) to the flare was slightly greater than in January, 2016 and the flare-measured flow of carbon dioxide (CO₂) (1,037 scfm) was less than January. The balance gas flow rate of 1,270 scfm in February 2016 was less than January (1,280 scfm).
- The average total flare flow rate of 2,907 scfm in February 2016 was less than the average total flare flow rate in January 2016 (2,997 scfm).

Flare data are subject to further examination, as meetings in late 2015 indicated the flow measurements for the overall gas collection system and flares were not accurate, and flow data for the mentioned systems were not accurately measured until after March 12, 2015 (per

MDNR). However, it is our understanding that flow data from individual GEWs and GIWs were accurate throughout 2015 and into 2016.

North Quarry

Temperature

February measurements showed three wells that exhibited a slight decrease in temperature in the middle of the month that corresponded with a large decline in applied vacuum to these wells. The remaining wells exhibited mostly steady temperatures when compared to January data. **The maximum temperature measured in North Quarry wells was approximately 124 °F (GEW-51).**

Data from several new TMPs in the North Quarry (TMP-16 through 18, and TMP-21 through 29) were examined, and the observed temperatures were all generally steady in February, with a few exceptions. **The 134-ft depth of TMP-16 exhibited an increase in temperature to about 140 °F**, the highest temperature recorded at this depth in 2016; the remaining depths at TMP-16 showed a concurrent temperature increase of a few degrees, but this may have been a function of the instrument's operation on the day of measurement. **TMP-21, -23, -24, and -26, all showed a similar increase of approximately 3 °F across all depths – this increase was coincident with that observed in TMP-16.** These temperatures will be closely watched over time to see if temperatures revert to a more stable trend – based on the current measurements, many of the temperatures observed are the highest since operation of these TMPs began.

Three TMPs (-16, -17, and -25) had at least one depth with a measured temperature greater than 160 °F, which is the same as seen in January, although TMP-27 had a couple of depths (60 ft and 80 ft) with a temperature just below 160 °F. These levels are generally consistent with historical values that have not exceeded 160 °F. This temperature was observed at two depths in TMP-25 and is slightly less than historical highs at this depth (60 ft and 80 ft).

Collected Gas Quality

February data showed similar trends as January, with respect to balance gas and pressure, with little vacuum (< 2" water column or w.c.) observed in most wells. Some wells showed an elevated balance gas concentration, with a maximum balance concentration of 26% measured at GEW-52. Laboratory data suggest that in nearly every case the elevated balance gas was composed of nitrogen (N₂). Similar to January, nearly all elevated balance gas measurements were accompanied by a low oxygen (O₂) concentration (< 1%), suggesting possible air intrusion in the wells with elevated N₂. The remaining wells exhibited conditions typical of normal anaerobic decomposition.

Settlement

No settlement data were collected for the North Quarry in February 2016.

Neck Area

Temperature

TMP measurements were mostly stable when compared to January 2016 data. Three TMPs showed a slight increase in temperature (TMP-4R at the 29-ft depth, TMP-11 at the 36-ft depth, and TMP-14 at the 81-ft. depth (maximum temperature of approximately 185 °F).

February data showed steady or increasing temperature trends in the GIWs, in slight contrast with January trends. Decreased temperatures occurred in multiple GIWs in the beginning of the month, which followed with an increase in temperature towards the end of the month. Temperatures remained < 100 °F for all GIWs retrofitted with the cooling loop system.

GEWs exhibited mostly steady temperature trends with decreased temperatures in some measurements in February, in contrast with January data. Pressure measurements remained steady towards the beginning of the month and then decreased to a point of no vacuum, which may explain the inconsistent temperature trends. Not enough data points are available to suggest any prolonged trend, but continued evaluation of this area in subsequent months could reveal trends.

Heat Extraction System (HES) Evaluation

TMPs installed adjacent to GIWs retrofitted with the HES (cooling loop system) were examined and compared to January data. February data displayed mostly increasing temperatures. The TMP-5 HES series all showed increased temperatures over multiple depths greater than 2 °F except for TMP-5-5S, which showed a decrease of 5 °F at 100-ft. depth. TMP-5-5N had the greatest temperature increase of 9 °F occurring at a 60-ft depth. TMP-10-5N showed declining temperatures at two depths, 20 and 40 ft. TMP-10-5S showed a decline at two depths, with the largest decline at the 40-ft depth of approximately 8 °F. The 140-ft depth at TMP-20 continued showing a temperature increase (approximately 6 °F, similar to the month-over-month increase seen from November, 2015 to January, 2016. Slight temperature increases were also observed at most depths of TMP-14R with an approximate average increase of 3 °F.

Similar to January, the TMPs continued showing higher temperatures than the adjacent GIWs, and the TMPs closer to the GIW generally had lower temperatures than those farther from the GIWs, indicating a localized cooling effect from the HES.

Generally, temperatures increased with depth, with measured maximum values between 200 °F and 250 °F.

Collected Gas Quality

Four of 14 GEWs exhibited elevated balance gas concentrations at least once during February. O₂ concentrations in these wells were low, except at two wells (GEW-38 and -110). When compared to the amount of balance gas present, O₂ concentrations in these wells suggest possible atmospheric air intrusion. The remaining wells exhibited balance gas < 20%, and O₂ < 10%.

All 13 GIWs exhibited elevated concentrations of balance gas and/or CO₂. Balance gas concentrations were elevated during the entire month, and the majority of GIWs had measured concentrations > 20%, with a maximum balance gas concentration of 71% at GIW-4. Several GIWs had slightly elevated O₂ concentrations relative to January. CH₄ concentrations were generally < 20% for the GIWs, except for GIW-07 and -08 that exhibited concentrations of approximately 30%.

Settlement

Limited elevation points were measured in the Neck Area, thus no assessment of settlement rates in the Neck Area is made here.

South Quarry

Temperature

- **No GEWs with data had temperatures > 200 °F. Thirty wells had measured temperatures ranging from 140 °F to 200 °F. Eighteen wells had measured temperatures < 100 °F.**
- **45 wells maintained an applied vacuum of at least 2" w.c. for the whole month.**
- **Two TMPs (TMP-31 and TMP-32) were examined. Temperature increases occurred at a few depths in TMP-32. A 7.5 °F increase occurred at 20-ft and a 3 °F increase occurred at both 180-ft and 200-ft depths.**

Collected Gas Quality

No GEWs in the South Quarry exhibited gas concentrations consistent with anaerobic waste decomposition conditions.

Settlement

The maximum settlement amount in February was 1.35 ft, which is slightly less than the maximum measured settlement of 1.53 ft from January. Surface elevation points reported in February were compared to surface elevation points collected in January, and a volume difference was calculated by analyzing surfaces created with both sets of data points using a computer-aided design (CAD) program. The analysis showed a decrease in volume of approximately 16,000 cubic yards (yd³) from January to February, 2016. This is less than the approximately 19,000 yd³ volume loss from December, 2015 to January, 2016. This value should be considered an estimate since there were some settlement points missing from February's data, and details on surface filling or removal activities were not available in the site's monthly report narrative.